

CLAIMS

1. A process for producing granular activated carbon by carbonization of suitable carbonaceous polymers in the form of polymer granules as a starting material,
5 which polymer granules are convertible by carbonization into carbon, wherein the polymer granules are continuously moved through a carbonization apparatus comprising a plurality of temperature zones so that a complete conversion of the starting material to carbon is effected, wherein the carbonization apparatus comprises at least the following temperature zones in the following order:
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 - a) optionally, a first temperature zone ("sulfonating zone") where in the case that the starting material contains no groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages or else in the case that such groups are to be additionally introduced into the starting
15 material, these groups are introduced into the starting material; then
 - b) a second temperature zone ("pre-carbonization zone" or "zone of acidic gases"), the second temperature zone having a higher average temperature than the first temperature zone, wherein in the second temperature zone the
20 groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages are split off from the starting material, so that carbonization and thermal decomposition of the starting material ensues, accompanied by crosslinking of the polymers and formation of carbon; and then
 - c) a third temperature zone ("post-carbonization zone"), the third carbonization
25 zone having a higher average temperature than the second temperature zone, wherein in the third temperature zone further carbonization of the starting material resulting from the second temperature zone is performed, so that a complete conversion of the starting material to carbon is effected;
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- wherein the individual temperature zones are separately and independently controlled.

2. The process according to claim 1, wherein the carbonization apparatus used is a continuous rotary tube or a continuous rotary tube oven.
- 5 3. The process according to claim 1, wherein the carbonization apparatus used is a belt-oven.
4. The process according to claim 1, wherein the polymer granules are continuously moved through the temperature zones of the carbonization apparatus by means of transporting or conveying means.
- 10 5. The process according to claim 1, wherein the individual temperature zones possess separate and independent exhaust means, so that the process gases from the different temperature zones are separated and separately collected.
- 15 6. The process according to claim 1, wherein the carbonization apparatus comprises at least one lock between individual successive temperature zones or within individual temperature zones, so that there is at least essentially no mixing through of process gases from different temperature zones between which at least one lock is disposed.
- 20 7. The process according to claim 6, wherein at least one lock is present between the second temperature zone and the third temperature zone, so that acidic process gases from the second temperature zone are not mixed with other process gases.
- 25 8. The process according to claim 1, wherein process control is performed by setting the temperature profile in the individual temperature zones.
9. The process according to claim 1, wherein process control is performed by setting the speed at which the starting material moves through the temperature zones of the carbonization apparatus.
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10. The process according to claim 1, wherein the total residence time of the starting material in the carbonization apparatus is in the range from 0.1 to 5 hours.
- 5 11. The process according to claim 1, wherein the first temperature zone is operated at temperatures in the range of from 50 to 200 °C.
12. The process according to claim 1, wherein the second temperature zone is operated at temperatures in the range of from 100 to 500 °C
- 10 13. The process according to claim 1, wherein the third temperature zone is operated at temperatures in the range of from 400 to 1.200 °C.
14. The process according to claim 1, wherein in the first temperature zone the groups which, when thermally decomposed, lead to free radicals and thus to cross-
15 linkages are sulfonic acid groups and are introduced into the starting material by sulfonation.
- 15 15. The process according to claim 1, wherein the starting material used comprises polymers in the form of polymer granules based on styrene and divinylbenzene
20 and containing chemical groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages.
16. The process according to claim 15, wherein the chemical groups leading to cross-linkages are sulfonic acid groups being already present in the starting material and
25 wherein the weight ratio of polymers to sulfonic acid groups is in the range from 5:1 to 1:1.
17. The process according to claim 15, wherein the starting material used comprises ion-exchanger resins having sulfonic acid groups or precursors of such ion-
30 exchanger resins.

18. The process according to claim 1, wherein the carbonized material is subsequently subjected to an activation.

5 19. A process for producing granular activated carbon by carbonization of suitable carbonaceous polymers in the form of polymer granules as a starting material, which polymer granules are convertible by carbonization into carbon, wherein the polymer granules are continuously moved through a carbonization apparatus comprising a plurality of temperature zones so that a complete conversion of the starting material to carbon is effected, wherein the carbonization apparatus
10 comprises at least the following temperature zones in the following order:

- 15 a) optionally, a first temperature zone ("sulfonating zone") where in the case that the starting material contains no groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages or else in the case that such groups are to be additionally introduced into the starting material, these groups are introduced into the starting material; then
- 20 b) a second temperature zone ("pre-carbonization zone" or "zone of acidic gases"), the second temperature zone having a higher average temperature than the first temperature zone, wherein in the second temperature zone the groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages are split off from the starting material, so that carbonization and thermal decomposition of the starting material ensues, accompanied by crosslinking of the polymers and formation of carbon; and then
- 25 c) a third temperature zone ("post-carbonization zone"), the third carbonization zone having a higher average temperature than the second temperature zone, wherein in the third temperature zone further carbonization of the starting material resulting from the second temperature zone is performed, so that a
30 complete conversion of the starting material to carbon is effected;

wherein the individual temperature zones are separately and independently controlled,

the carbonization apparatus further comprising at least one lock between individual successive temperature zones or within individual temperature zones, so that there is at least essentially no mixing through of process gases from different temperature zones between which said at least one lock is disposed.

20. A process for producing granular activated carbon by carbonization of suitable carbonaceous polymers in the form of polymer granules as a starting material, which polymer granules are convertible by carbonization into carbon, wherein the polymer granules are continuously moved through a carbonization apparatus comprising a plurality of temperature zones so that a complete conversion of the starting material to carbon is effected, wherein the carbonization apparatus comprises at least the following temperature zones in the following order:
- a) optionally, a first temperature zone ("sulfonating zone") where in the case that the starting material contains no groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages or else in the case that such groups are to be additionally introduced into the starting material, these groups are introduced into the starting material; then
 - b) a second temperature zone ("pre-carbonization zone" or "zone of acidic gases"), the second temperature zone having a higher average temperature than the first temperature zone, wherein in the second temperature zone the groups which, when thermally decomposed, lead to free radicals and thus to cross-linkages are split off from the starting material, so that carbonization and thermal decomposition of the starting material ensues, accompanied by crosslinking of the polymers and formation of carbon; and then
 - c) a third temperature zone ("post-carbonization zone"), the third carbonization zone having a higher average temperature than the second temperature zone, wherein in the third temperature zone further carbonization of the starting material resulting from the second temperature zone is performed, so that a complete conversion of the starting material to carbon is effected;

wherein the individual temperature zones are separately and independently controlled,

- 5 with at least one lock being present between the second temperature zone and the third temperature zone, so that acidic process gases from the second temperature zone are not mixed with other process gases.

ABSTRACT OF THE DISCLOSURE

5 The invention relates to a process for producing granular, particularly spherical
activated carbon by carbonization of suitable carbonaceous polymers in the form of
polymer granules, in particular polymer spherules, as a starting material, which are
convertible by carbonization into carbon at least essentially, wherein the polymer
granules, in particular the polymer spherules, are continuously moved through a
carbonization apparatus comprising a plurality of temperature zones and/or a
temperature gradient so that an at least essentially complete conversion of the starting
10 material to carbon is effected.